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Nanoscale engineering of 3D graphene foams for enzyme immobilization and enhanced bioelectrocatalysis

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Immobilization of enzymes on a solid support is an essential step for many crucial applications associated with biosensing devices, biofuel cells and industrial catalysis. To this end, retaining the native structures and biocatalytic activity of enzymes upon immobilization is required but has consistently posed challenges to match practical applications. Among all possible considerations, the choice of material type and structures of a solid support is a key factor. Graphene based nanomaterials have offered newly emerging opportunities for the immobilization of various enzymes, mainly because of their large specific surface area, high electrical conductivity, good mechanical strength, tunable flexibility and biological compatibility[1].

In this study, we have attempted to use three-dimensional graphene foams (3D-GFs) as a flexible supporting material for accommodating Rhizoctonia solani laccase (Rsl). Biotin and neutravidin were used as the linking molecules for covalent attachment of laccase onto the 3D-GFs (**Figure 1, left**). The biocatalytic activity of the immobilized enzyme towards oxygen reduction reaction (ORR) was systematically studied using 2,2′-azinobis (3-ethylbenzothiazoline-6-sulfonate) diammonium salt (ABTS) as an electron-transfer mediator (**Figure 1, right**). The results suggest that the newly engineered bioelectrode holds promising potential for construction of enzymatic biofuel cells (EBFCS).

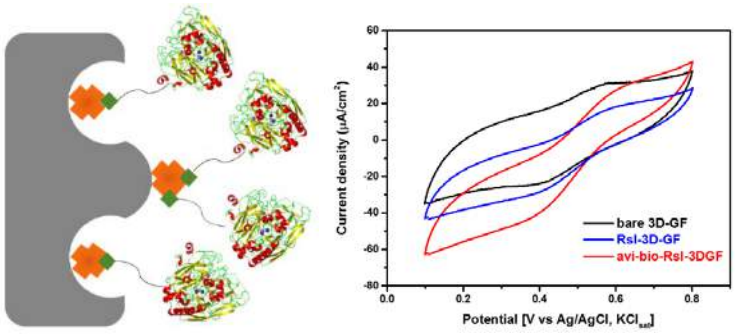

Figure 1. Schematic illustration of covalent immobilization of laccase on 3D graphene foam and its electrochemical behavior. Not drawn to scale.

References

[1] D. R. Dreyer, *et al.*, *Chem. Soc. Rev*. **39**, 228-240 (2010).

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